

CLAIMS

What is claimed is:

1. Method of fabricating an electrical contact structure, comprising:
5 configuring a flexible elongate member to have a springable shape, said elongate member having a length;
selecting an overcoat material for its structural characteristics; and
applying the overcoat material onto the elongate member.
- 10 2. Method, according to claim 1, wherein:
the resulting contact structure exhibits both elasticity and plasticity.
- 15 3. Method, according to claim 1, wherein:
the elongate member serves as a falsework for the resulting resilient electrical contact structure; and
the overcoat material serves as a superstructure for the resulting resilient electrical contact structure.
- 20 4. Method, according to claim 1, further comprising:
leaving the elongate member in place after applying the overcoat.
- 25 5. Method, according to claim 1, further comprising:
at least partially removing the elongate member after applying the overcoat.
6. Method, according to claim 5, further comprising:
fully removing the elongate member after applying the overcoat material.

Method, according to claim 1,
wherein the elongate member is formed of a first material
having a melting temperature; and
further comprising:

5 prior to applying the overcoat material, coating the
elongate member with a second material which is dissimilar from the
first material and which is capable of forming an alloy with the
first material, said alloy having a lower melting temperature than
the melting temperature of the first material.

10 8. Method, according to claim 6, further comprising:
after applying the overcoat, heating the resulting
resilient contact structure to form said alloy.

15 9. Method, according to claim 7, wherein the elongate member
is a gold wire, and further comprising:

prior to applying the overcoat material, applying a layer
of tin over the gold wire.

20 10. Method, according to claim 1, wherein:
the overcoat material has a set of structural properties;
and

the resulting resilient electrical contact structure has
a resilience which is determined primarily by the structural
properties of the overcoat material.

25 11. Method, according to claim 1, wherein:
the elongate member has a set of physical properties;
and

the resulting electrical contact structure has a
compliance which is determined by the structural properties of the
overcoat and the physical properties of the elongate member.

Method, according to claim 1, wherein:
the overcoat material is applied to the elongate member
by plating.

13. Method, according to claim 12, further comprising:
5 while plating the elongate member, applying heat to
create a thermal gradient along the length of the elongate member.

14. Method, according to claim 12, further comprising:
causing a thickness of the overcoat material to be
greater at a one end of the elongate member than at an opposite end
10 of the elongate member.

15. Method, according to claim 1, further comprising:
prior to configuring the elongate member to have a
springable shape, bonding a proximal end of the elongate member to
a contact area on a substrate.

16. Method, according to claim 15, wherein:
15 the proximal end of the elongate member is bonded to the
contact area with a wirebonder.

17. Method, according to claim 15, further comprising:
applying the overcoat material along the length of the
elongate member and over the contact area.
20

18. Method, according to claim 17, wherein:
the overcoat material is continuous over the contact area
and along the length of the elongate member.

19. Method, according to claim 15, further comprising:
25 after configuring the elongate member to have a
springable shape, severing the elongate member to have a distal
end.

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- Method, according to claim 19, further comprising:
severing the elongate member with an electrical discharge
from an electrode.
- 5
21. Method, according to claim 20, further comprising:
while severing the elongate member with the electrical
discharge, illuminating at least one of the elongate member and the
electrode with ultraviolet light.
- 10
22. Method, according to claim 19, further comprising:
severing the elongate member with a tool.
- 15
- .23. Method, according to claim 1, further comprising:
while configuring the elongate member, applying
ultrasonic vibrations to the elongate member.
- 20
24. Method, according to claim 1, wherein:
the overcoat material is electrically conductive.
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25. Method, according to claim 1, wherein:
the overcoat material comprises multiple layers of
material; and
at least one layer of the overcoat is electrically
conductive.
- 25
26. Method, according to claim 1, wherein:
the overcoat is applied by a technique selected from a
group consisting of wet electrochemical techniques, including
electrolytic or electroless aqueous solution plating of metals;
electroplating, chemical vapor deposition (CVD), physical vapor
deposition (PVD), and any process that causes deposition of
materials through decomposition or reaction of gaseous, liquid or
solid precursors.

- 2 Method, according to claim 1, further comprising:
attaching a contact pad at a free end of the elongate
member.
- 5 28. Method, according to claim 27, wherein:
the contact pad is attached to the one end of the
elongate member prior to applying the overcoat material.
- 10 29. Method, according to claim 27, wherein:
the contact pad is attached to the one end of the
elongate member after applying the overcoat material; and
further comprising:
after attaching the contact pad, applying an additional
overcoat material.
- 15 30. Method, according to claim 27, further comprising:
forming a desired topography on a surface of the contact
pad.
- 20 31. Method, according to claim 1, further comprising:
imparting a desired topography to a free end of the
resulting contact structure.
- 25 32. Method of electrically interconnecting two electronic
components, comprising:
bonding a proximal end of a flexible wire to a contact
area on a surface of a first electronic component;
configuring the wire to have a springable shape;
severing the wire to have a distal end;
overcoating the wire and the contact area with an
electrically conductive, resilient material, thereby forming a
freestanding resilient contact structure mounted by a proximal end
to the first electronic component and having a distal end; and
30 contacting a contact area on a second electronic
component with the distal end of the resilient contact structure.

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33. Method, according to claim 32, wherein:
the freestanding resilient contact structure exhibits
both plasticity and elasticity.
34. Method, according to claim 32, further comprising:
5 attaching the distal end of the freestanding resilient
contact structure to the second electronic component with a
conductive material selected from the group consisting of solder
and conductive epoxy.
35. Method, according to claim 32, further comprising:
10 prior to contacting the contact area on the second
electronic component, mounting a contact pad to the distal end of
the flexible wire.
36. Method of fabricating an interposer, comprising:
15 providing an interposer substrate having holes extending
therethrough;
providing a sacrificial substrate;
fabricating resilient contact structures on the
sacrificial substrate;
20 causing the resilient contact structures to extend
through the holes and to be suspended in the holes; and
removing the sacrificial substrate.
37. Method, according to claim 36, further comprising:
25 causing the resilient contact structures to be suspended
within the holes of the interposer substrate with an elastomeric
material.
38. Method, according to claim 35, further comprising:
soldering the resilient contact structures within the
holes in the interposer substrate.

Method of mounting a plurality of contact structures to
an electronic component, comprising:

5 fabricating a plurality of electrical contact structures
on a sacrificial substrate, each of the electrical contact
structures having a tip extending from the sacrificial substrate;
and

10 bringing the sacrificial substrate into proximity with
an electronic component so that the tips of the electrical contact
structures contact the electronic component;

15 in a single step, mounting the electrical contact structures
by their tips to the electronic component; and

20 after mounting the electrical contact structures to the
electronic component, removing the sacrificial substrate.

25 40. Method, according to claim 39, further comprising:

30 after removing the sacrificial substrate, plating the
electrical contact structures.

35 41. Method of performing testing selected from the group
consisting of test and burn-in on a semiconductor device,
comprising:

40 mounting resilient contact structures directly to a
semiconductor device;

45 urging the semiconductor device against a test board,
said test board having contact areas, so that tips of the resilient
contact structures are electrically connected to the contact areas
50 on the test board;

55 performing testing on the semiconductor device;

60 subsequently mounting the semiconductor device to a
system board, said system board having contact areas, so that the
tips of the resilient contact structures are electrically connected
65 to the contact areas on the system board.

Method, according to claim 41, further comprising:
permanently connecting the semiconductor device to the
system board.

43. Method, according to claim 41, further comprising:
5 mounting the resilient contact structures to the
semiconductor devices prior to singulating the semiconductor
devices from a semiconductor wafer.

44. Method, according to claim 41, further comprising:
mounting the resilient contact structures to the
10 semiconductor devices after singulating the semiconductor devices
from a semiconductor wafer.

45. Method of temporarily connecting to a semiconductor
device prior to permanently connecting to the semiconductor device,
comprising:

15 mounting a plurality of electrical contact structures to
a bare semiconductor device;

urging the semiconductor device against a first
electronic component to effect a temporary connection between the
semiconductor device and the first electronic component, with the
electrical contact structures serving as an electrical interconnect
between the semiconductor device and the first electronic
component; and

25 using the same electrical contact structures mounted to
the semiconductor device to effect a permanent connection between
the semiconductor device and a second electronic component.

46. Method, according to claim 45, further comprising:
effecting the permanent connection by mechanically
biasing the semiconductor device against the second electronic
component.

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- Method, according to claim 45, further comprising:
permanently connecting the semiconductor device to the
second electronic component.
48. Method, according to claim 45, wherein:
the electrical contact structures are resilient.
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49. Method, according to claim 45, wherein:
the electrical contact structures are compliant.
50. Electrical connection between two electronic components,
comprising:
10 a conductive path consisting essentially of a metallic
coating having at least one electrically-conductive layer, said
metallic coating disposed on an elongate member, said coating
extending between and interconnecting two electronic components.
51. Electrical connection, according to claim 50, wherein:
the coating is a plating having at least one layer.
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52. Electrical connection, according to claim 50, wherein:
the elongate member is a wire.
53. Electrical connection, according to claim 52, wherein:
the wire is electrically conductive.
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54. Electrical connection, according to claim 52, wherein:
the wire is a selected from a group consisting of gold
and its alloys.
55. Electrical connection, according to claim 52, wherein:
the wire is a selected from a group consisting of
25 aluminum, copper, metals of the platinum group, lead, tin, indium,
and their alloys;

Electrical connection, according to claim 50, wherein:
the coating is selected from a material and the elongate
member is configured so as to impart resiliency to the electrical
connection.

5 57. Electrical connection, according to claim 50, wherein:
the plating is a material selected from the group
consisting of nickel and its alloys.

10 58. Electrical connection, according to claim 50, wherein:
the plating is a material selected from the group
consisting of copper, cobalt, iron, and their alloys, and Ni/Fe/Co
materials.

15 59. Electrical connection, according to claim 50, wherein:
the plating is a material selected from the group
consisting of gold, silver, elements of the platinum group,
noble or semi-noble metals and their alloys, tungsten, molybdenum,
cobalt, zinc, tin, solder, and copper.

20 60. Electronic assembly, comprising:
a plurality of semiconductor dies mounted edge-to-edge,
in close proximity to one another, on at least one side of a
printed circuit board, each semiconductor die electrically
connected to the printed circuit board by free-standing, resilient
contact structures mounted to each of the semiconductor dies.

25 61. Electronic assembly, according to claim 60, wherein:
the semiconductor dies are memory devices.

62. Electronic assembly, according to claim 60, wherein:
the electronic assembly is a single in-line memory module
(SIMM).

6. Electronic assembly, according to claim 60, wherein:
the resilient contact structures are compliant.
64. Electronic assembly, according to claim 60, wherein:
the semiconductor dies are mounted to both sides of the
printed circuit board.
65. Electronic assembly, according to claim 60, wherein:
the freestanding resilient contact structures are formed
by:
individually bonding wires to the semiconductor dies; and
overcoating the wires contemporaneously with one another.
66. Electronic assembly, according to claim 60, wherein:
the freestanding resilient contact structures are formed
by:
individually bonding wires to a sacrificial substrate;
plating the wires; and
gang-transferring the plated wires to at least one of the
semiconductor dies in a single step.
67. Electronic assembly, according to claim 66, further
comprising:
after gang-transferring the plated wires, further plating
the plated wires.
68. Electronic assembly, according to claim 60, further
comprising:
a rigidizing material encapsulating at least a portion
of the resilient contact structures.
69. Method of creating a superstructure on a falsework,
comprising:
mounting at least one falsework on an electronic
component;

disposing the substrate in a plating bath to form a superstructure on the at least one falsework.

70. Method, according to claim 69 further comprising:
prior to plating the at least one falsework, configuring
5 each one of the at least one falseworks to have a springable shape.

71. Method, according to claim 69, further comprising:
while plating the at least one falsework, heating the
electronic component.

72. Method, according to claim 71, wherein:
10 the resulting plating exhibits a thickness gradient of
at least 1.5:1 from a thickest portion of the plating to a thinnest
portion of the plating.

73. Method, according to claim 69, wherein:
15 at least two falseworks are mounted on the electronic
component; and
the falseworks are free-standing, having a proximal end
mounted to the substrate and a distal end; and
further comprising:
configuring the falseworks to have a greater spacing at
20 their distal ends than at their proximal ends.

74. Method, according to claim 69, wherein:
the falseworks are free-standing, having a proximal end
mounted to the substrate and a distal end; and
further comprising:
25 prior to plating the at least one falsework, applying a
masking material to the distal ends of the falseworks; and
after plating the falseworks, removing the masking
material.

75. Method, according to claim 74, further comprising:
after removing the masking material, further plating the
falseworks.

76. Method, according to claim 69, further comprising:
5 after forming the superstructure on the falsework,
removing a portion of the superstructure to expose the falsework.

77. Method, according to claim 69, further comprising:
prior to plating the falseworks, applying a material onto
the falsework which is suitable for forming an alloy with the
10 falsework which exhibits a lower melting temperature than that of
the falsework.

78. Method, according to claim 69, wherein:
15 the falseworks are free-standing, having a proximal end
mounted to the electronic component, and having a distal end, and
further comprising:

prior to plating the at least one falsework, applying a
masking material to the distal ends of the falseworks;

after plating the falseworks, removing the masking
material; and

20 after removing the masking material, heating the plated
falseworks.

79. Method, according to claim 69, wherein:
25 the falseworks are free-standing, having a proximal end
mounted to the electronic component and a distal end, and a length
therebetween and further comprising:

prior to plating the at least one falsework, applying a
masking material to a one side of each falsework, along its length;

after plating the falseworks, removing the masking
material; and

30 after removing the masking material, heating the plated
falseworks.

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80. Method of tailoring the thickness of a plating, comprising:
disposing a member to be plated in a plating bath; and
creating a temperature gradient on the member, while
plating the member.
81. Method, according to claim 80, further comprising:
creating the temperature gradient with a heat source selected from the group consisting of a resistive heat element, a thermocouple device, a Peltier-type device, an incandescent radiant heat source and a coherent light source.
82. A method of making two or more free-standing resilient contact structures, comprising:
forming a loop having two ends, a first of the two ends attached to a first terminal, a second of the two ends attached to a second terminal, a bight portion of the loop disposed approximately midway along the loop, a first leg portion extending from the first end to the bight portion, and a second leg extending from the second end to the bight portion; and
removing the bight portion.
83. Method, according to claim 82, further comprising:
overcoating the loop prior to removing the bight portion.
84. Method, according to claim 82, further comprising:
overcoating the loop after removing the bight portion.
85. Method, according to claim 82, further comprising:
prior to removing the bight portion, encapsulating the loop with a rigidizing material.
86. Method, according to claim 85, further comprising:
removing the bight portion by grinding.

87. Method, according to claim 86, further comprising:
after removing the bight portion, removing the
encapsulant material.

88. A method for mounting a protuberant conductive contact
5 to an electronic component, the method comprising the sequential
steps of:

providing a wire having a continuous feed end,
bonding the feed end to the component,

10 forming, from the bonded feed end, a stem which protrudes
from the component, said stem having a first stem end which is the
bonded feed end,

15 severing the stem at a second stem end to define a
skeleton,

depositing a metallic conductive material to envelop the
skeleton and adjacent surface of the component.

89. The method as claimed in Claim 88, further comprising:
prior to the severing step, bonding the second stem end
to the component.

90. A method for mounting a protuberant conductive
contact to an electronic component, the method comprising the
sequential steps of:

providing a wire having a continuous feed end,
bonding the feed end to the component,

25 forming, from the bonded feed end, a stem which protrudes
from the component, said stem having a first stem end which is the
bonded feed end,

severing the stem at a second stem end to define a
skeleton,

30 depositing a metallic conductive material to jacket the
skeleton and adjacent surface of the component.

9 The method as claimed in Claim 88, further comprising:
 after the severing step, continuing sequentially the
bonding step and the forming step and the severing step for a
predetermined number of stems to comprise the skeleton.

5 92. The method as claimed in Claim 91, further comprising:
 before each of the severing steps, each of the second
stem ends is bonded to the component.

10 93. A method for mounting a protuberant conductive contact
to a conductive terminal on an electronic component, the method
comprising the sequential steps of:

15 providing a wire having a continuous feed end,
 bonding the feed end to the terminal,
 forming, from the bonded feed end, a stem which protrudes
from the terminal, said stem having a first stem end which is the
bonded feed end,
 severing the stem at a second stem end to define a
skeleton,
 depositing a metallic conductive material to envelop the
skeleton and adjacent surface of the terminal.

20 94. The method as claimed in Claim 93, further comprising:
 before the severing step, bonding the second stem to
the terminal.

25 95. The method as claimed in Claim 93, further comprising:
 after the severing step, continuing sequentially the
bonding step and the forming step and the severing step for a
predetermined number of stems to comprise the skeleton.

96. The method as claimed in Claim 95, further comprising:
 before each of the severing steps, each of the second
stem ends is bonded to the terminal.

9. A method for mounting a protuberant conductive contact to a conductive terminal on an electronic component, the method comprising the sequential steps of:

5 providing a wire having a continuous feed end,

bonding the feed end to the terminal,

10 forming, from the bonded feed end, a stem which protrudes from the terminal, said stem having a first stem end which is the bonded feed end,

15 severing the stem at a second stem end to define a skeleton,

20 depositing a metallic conductive material to jacket the skeleton and adjacent surface of the terminal.

25 98. The method as claimed in Claim 97, further comprising:
before the severing step, bonding the second stem end to
the terminal.

30 99. The method as claimed in Claim 97, further comprising:
after the severing step, continuing sequentially the bonding step and the forming step and the severing step for a predetermined number of stems to comprise the skeleton.

100. The method as claimed in Claim 99, further comprising:
before each of the severing steps, each of the second stem ends is bonded to the terminal.

101. A method for mounting a protuberant conductive contact to a conductive terminal on an electronic component, the method comprising the sequential steps of:

25 providing a wire having a continuous feed end and a length,

30 in a first bonding step, bonding the feed end to the terminal,

forming, from the bonded feed end, a stem which protrudes from the terminal, said stem having a first stem end which is

the bonded feed end,

sequentially bonding intermediate portions along the length of the wire to the terminal, forming protruding stem segments between each pair of bonds, and

5 in a final bonding step, severing the wire to define a skeleton, and

depositing a metallic conductive material to envelop the skeleton and adjacent surface of the electronic component .

102. A method for mounting a protuberant conductive contact to a conductive terminal on an electronic component, the method comprising the sequential steps of:

providing a wire having a continuous feed end,

bonding the feed end to the terminal,

15 forming, from the bonded feed end, a stem which protrudes from the terminal and has a first stem end,

severing the stem at a second stem end to define a skeleton,

depositing a conductive material to envelop the skeleton and adjacent surface of the terminal,

20 further comprising:

performing the method on a plurality of the terminals and,

wherein:

25 the forming steps result in a plurality of free-standing protuberant stems,

the severing steps are performed on the respective stems all in a common plane.

103. The method as claimed in Claim 102, wherein:

the terminals are in different planes.

30 104. The method as claimed in Claim 93, performed on a plurality of terminals on at least one electronic component, wherein shapes of the skeleton and mechanical properties of the

conductive material are organized collectively to impart resilience to the protuberant conductive contacts, and the severing steps are performed on all the stems in a common plane.

105. The method as claimed in Claim 88, wherein the cross-section of the wire is rectangular.

106. The method as claimed in Claim 88, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys, and

at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

107. The method as claimed in Claim 101, further comprising:

performing the method on at least one terminal on an electronic component, wherein:

the wire is made primarily of a metal selected from a group consisting of gold, copper, aluminum, silver, lead, tin, indium and their alloys ;

the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys ;

a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and alloys thereof and their alloys ..

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- 1 . The method as claimed in Claim 90, further comprising:
after the severing step, continuing sequentially the
bonding step and the forming step and the severing step for a
predetermined number of stems to comprise the skeleton.
- 5 109. The method as claimed in Claim 108, further comprising:
before each of the severing steps, each of the second
stem ends is intimately bonded to the component.
- 10 110. The method as claimed in Claim 90, further comprising:
before the severing step, bonding the second stem to the
electronic component.
- 15 111. The method as claimed in Claim 90, further comprising:
after the severing step, continuing sequentially the
bonding step and the forming step and the severing step for a
predetermined number of stems to comprise the skeleton.
- 20 112. The method as claimed in Claim 90, further comprising:
before each of the severing steps, each of the second
stem ends is bonded to the electronic component.
113. The method as claimed in Claim 94, further comprising:
before each of the severing steps, each of the second
stem ends is bonded to the terminal.
- 25 114. The method as claimed in Claim 101, wherein the severing
step occurs at substantially the same location as the first bonding
step, and the protruding stem segments define a bounded spatial
area.
115. The method as claimed in Claim 114, wherein the
conductive material is solder.

1. The method as claimed in Claim 115, wherein the solder covers the skeleton and the bounded spatial area.
- 5 117. The method as claimed in Claim 116, further comprising: disposing the electronic component on a heat sink, with the solder of the bounded spatial area in contact with the heat sink.
- 10 118. The method as claimed in Claim 116, further comprising: disposing the electronic component on a substrate with the solder of the bounded spatial area in contact with the substrate.
- 15 119. The method as claimed in Claim 88, performed on a plurality of the terminals on the electronic component.
- 20 120. The method as claimed in Claim 90, performed on a plurality of the terminals on the electronic component.
- 25 121. The method as claimed in Claim 93, performed on a plurality of the terminals on the electronic component.
122. The method as claimed in Claim 101, performed on a plurality of the terminals on the electronic component.
123. The method as claimed in claim 93, performed on a plurality of wires on a plurality of the terminals on the electronic component.
124. The method as claimed in Claim 93, wherein: the severing of the second end is performed by melting the wire.
- 25 125. The method as claimed in Claim 93, wherein: the severing of the second end is performed by mechanical

shear

5 126. The method as claimed in Claim 88, performed on a plurality of the terminals, wherein a shape of the skeleton and mechanical properties of the conductive material are organized collectively to impart resilience to the protuberant conductive contact.

10 0 127. The method as claimed in Claim 89, performed on a plurality of the terminals, wherein a shape of the skeleton and mechanical properties of the conductive material are organized collectively to impart resilience to the protuberant conductive contact.

15 128. The method as claimed in Claim 90, performed on a plurality of the terminals, wherein a shape of the skeleton and mechanical properties of the conductive material are organized collectively to impart resilience to the protuberant conductive contact.

20 129. The method as claimed in Claim 91, performed on a plurality of the terminals, wherein a shape of the skeleton and mechanical properties of the conductive material are organized collectively to impart resilience to the protuberant conductive contact.

25 130. The method as claimed in Claim 93, performed on a plurality of the terminals, wherein a shape of the skeleton and mechanical properties of the conductive material are organized collectively to impart resilience to the protuberant conductive contact.

131. The method as claimed in Claim 95, performed on a plurality of the terminals, wherein a shape of the skeleton and mechanical properties of the conductive material are organized

collectively to impart resilience to the protuberant conductive contact.

132. The method as claimed in Claim 88, wherein:
the conductive material is provided with a multitude of
5 microprotrusions on its surface.

133. The method as claimed in Claim 89, wherein:
the conductive material is provided with a multitude of
micropromtrusions on its surface.

134. The method as claimed in Claim 90, wherein:
the conductive material is provided with a multitude of
10 microprotrusions on its surface.

135. The method as claimed in Claim 91, wherein:
the conductive material is provided with a multitude of
micropromtrusions on its surface.

136. The method as claimed in Claim 93, wherein:
the conductive material is provided with a multitude of
15 microprotrusions on its surface.

137. The method as claimed in Claim 88, wherein:
the conductive material enveloping the skeleton and at
20 least the adjacent surface of the component comprises a plurality
of dissimilar layers.

138. The method as claimed in Claim 89, wherein:
the conductive material enveloping the skeleton and at
25 least the adjacent surface of the component comprises a plurality
of dissimilar layers.

1. The method as claimed in Claim 90, wherein:
the conductive material enveloping the skeleton and at
least the adjacent surface of the component comprises a plurality
of dissimilar layers.

5 140. The method as claimed in Claim 91, wherein:
the conductive material enveloping the skeleton and at
least the adjacent surface of the component comprises a plurality
of dissimilar layers.

10 141. The method as claimed in Claim 93, wherein:
the conductive material enveloping the skeleton and at
least the adjacent surface of the component comprises a plurality
of dissimilar layers.

15 142. The method as claimed in Claim 95, wherein:
the conductive material enveloping the skeleton and at
least the adjacent surface of the component comprises a plurality
of dissimilar layers.

20 143. The method as claimed in Claim 88, further comprising:
performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;
wherein the depositing step includes placement of a
plurality of layers each differing from one another.

25 144. The method as claimed in Claim 89, further comprising:
performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;
wherein the depositing step includes placement of a
plurality of layers each differing from one another.

5 145. The method as claimed in Claim 90, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

 wherein the depositing step includes placement of a
plurality of layers each differing from one another.

10 146. The method as claimed in Claim 91, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

 wherein the depositing step includes placement of a
plurality of layers each differing from one another.

15 147. The method as claimed in Claim 93, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

20 wherein the depositing step includes placement of a
plurality of layers each differing from one another.

25 148. The method as claimed in Claim 95, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

 wherein the depositing step includes placement of a
plurality of layers each differing from one another.

14 . The method as claimed in Claim 88, further comprising:
performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

5 wherein the depositing step includes placement of a
plurality of layers each differing from one another; and

10 wherein at least one of the layers comprising conductive
material has a jagged topography in order to reduce contact
resistance of the protuberant conductive contact when mated to a
matching terminal.

150. The method as claimed in Claim 89, further comprising:
performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

20 wherein the depositing step includes placement of a
plurality of layers each differing from one another; and

25 wherein at least one of the layers comprising conductive
material has a jagged topography in order to reduce contact
resistance of the protuberant conductive contact when mated to a
matching terminal.

151. The method as claimed in Claim 90, further comprising:
performing the method on a plurality of the terminals,
25 wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

30 wherein the depositing step includes placement of a
plurality of layers each differing from one another; and

35 wherein at least one of the layers comprising conductive
material has a jagged topography in order to reduce contact
resistance of the protuberant conductive contact when mated to a
matching terminal.

5 152. The method as claimed in Claim 91, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

0 wherein the depositing step includes placement of a
plurality of layers each differing from one another; and

.0 wherein at least one of the layers comprising conductive
material has a jagged topography in order to reduce contact
resistance of the protuberant conductive contact when mated to a
matching terminal.

5 153. The method as claimed in Claim 93, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

0 wherein the depositing step includes placement of a
plurality of layers each differing from one another; and

.0 wherein at least one of the layers comprising conductive
material has a jagged topography in order to reduce contact
resistance of the protuberant conductive contact when mated to a
matching terminal.

25 154. The method as claimed in Claim 95, further comprising:
 performing the method on a plurality of the terminals,
wherein a shape of the skeleton and mechanical properties of the
conductive material are organized collectively to impart resilience
to the protuberant conductive contact;

0 wherein the depositing step includes placement of a
plurality of layers each differing from one another; and

0 wherein at least one of the layers comprising conductive
material has a jagged topography in order to reduce contact
resistance of the protuberant conductive contact when mated to a

matchi' terminal.

155. The method as claimed in Claim 88, wherein:
the deposition is performed by a process of
electrochemical plating in an ionic solution.
- 5 156. The method as claimed in Claim 89, wherein:
the deposition is performed by a process of
electrochemical plating in an ionic solution.
- 10 157. The method as claimed in Claim 90, wherein:
the deposition is performed by a process of
electrochemical plating in an ionic solution.
- 15 158. The method as claimed in Claim 91, wherein:
the deposition is performed by a process of
electrochemical plating in an ionic solution.
- 20 159. The method as claimed in Claim 93, wherein:
the deposition is performed by a process of
electrochemical plating in an ionic solution.
160. The method as claimed in Claim 95, wherein:
the deposition is performed by a process of
electrochemical plating in an ionic solution.
- 20 161. Method, as set forth in claim 88, wherein:
the conductive material is deposited by an electroless
plating process.
- 15 162. Method, as set forth in claim 90, wherein:
the conductive material is deposited by an electroless
plating process.

1 . Method, as set forth in claim 93, wherein:
the conductive material is deposited by an electroless
plating process.

164. Method, as set forth in claim 97, wherein:
5 the conductive material is deposited by an electroless
plating process.

165. Method, as set forth in claim 88, further comprising:
during deposition of the conductive material, causing a
compressive internal stress in the conductive material.

10 166. Method, as set forth in claim 90, further comprising:
during deposition of the conductive material, causing a
compressive internal stress in the conductive material.

15 167. Method, as set forth in claim 93, further comprising:
during deposition of the conductive material, causing a
compressive internal stress in the conductive material.

168. Method, as set forth in claim 97, further comprising:
during deposition of the conductive material, causing a
compressive internal stress in the conductive material.

20 169. A method for mounting a protuberant conductive contact
to a conductive terminal on an electronic component, the method
comprising the sequential steps of:

25 providing a wire having a continuous feed end,
bonding the feed end to the terminal,
forming, from the bonded feed end, a stem which protrudes
from the terminal and has a first stem end,
severing the stem at a second stem end to define a
skeleton,
depositing a conductive material to envelop the skeleton
and adjacent surface of the terminal,

further comprising:

after the severing step, continuing sequentially the bonding step and the forming step and the severing step for a predetermined number of stems to comprise the skeleton,

5 further comprising:

performing the method on a plurality of the terminals and,

wherein:

10 the forming steps result in a plurality of free-standing protuberant stems,

the severing steps are performed on the respective stems all in a common plane.

170. The method as claimed in Claim 169, wherein:

the terminals are in different planes.

171. The method as claimed in Claim 95, performed on a plurality of terminals on at least one electronic component, wherein shapes of the skeleton and mechanical properties of the conductive material are organized collectively to impart resilience to the protuberant conductive contacts, and the severing steps are performed on all the stems in a common plane.

172. The method, as claimed in Claim 88, wherein:

the cross-sectional area of the wire is rectangular.

173. The method as claimed in Claim 90, wherein:

25 the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys, and

30 the conductive material is deposited as a plurality of layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous,

boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

174. The method as claimed in Claim 93, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys, and

the conductive material is deposited as a plurality of layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

175. The method as claimed in Claim 97, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys, and

the conductive material is deposited as a plurality of layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

176. The method as claimed in Claim 88, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys.

177. The method as claimed in Claim 90, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys.

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178. The method as claimed in Claim 93, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys.

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179. The method as claimed in Claim 97, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys.

.5

180. The method as claimed in Claim 101, wherein:

the wire is made of a metal selected from a group consisting of gold, silver, beryllium, copper, aluminum, rhodium, ruthenium, palladium, platinum, cadmium, tin, lead, indium, antimony, phosphorous, boron, nickel, magnesium, and their alloys.

:0

181. The method as claimed in Claim 88, wherein:

the conductive material is deposited as a plurality of layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

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182. The method as claimed in Claim 90, wherein:

the conductive material is deposited as a plurality of

layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

183. The method as claimed in Claim 93, wherein:

the conductive material is deposited as a plurality of layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

184. The method as claimed in Claim 97, wherein:

the conductive material is deposited as a plurality of layers, and at least one of the layers of the conductive material is a metal selected from a group consisting of nickel, phosphorous, boron, cobalt, iron, chromium, copper, zinc, tungsten, tin, lead, bismuth, indium, cadmium, antimony, gold, silver, rhodium, palladium, ruthenium, and their alloys.

185. A method, according to claim 88, further comprising:

performing the method on at least one terminal on an electronic component, wherein:

the wire is made primarily of a metal selected from a group consisting of gold, copper, aluminum, silver, lead, tin, indium and their alloys;

the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys;

a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and alloys thereof and their alloys .

186. The method as claimed in Claim 89, further comprising:
performing the method on at least one terminal on an
electronic component, wherein:

5 the wire is made primarily of a metal selected from a
group consisting of gold, copper, aluminum, silver, lead, tin,
indium and their alloys;

.0 the skeleton is coated with a first layer of the
conducting material selected from a group consisting of nickel,
cobalt, boron, phosphorous, copper, tungsten, titanium, chromium,
and their alloys;

.5 a top layer of the conductive material is solder selected
from a group consisting of lead, tin, indium, bismuth, antimony,
gold, silver, cadmium and alloys thereof and their alloys .

187. The method as claimed in Claim 90, further comprising:

5 performing the method on at least one terminal on an
electronic component, wherein:

10 the wire is made primarily of a metal selected from a
group consisting of gold, copper, aluminum, silver, lead, tin,
indium and their alloys;

15 the skeleton is coated with a first layer of the
conducting material selected from a group consisting of nickel,
cobalt, boron, phosphorous, copper, tungsten, titanium, chromium,
and their alloys;

20 a top layer of the conductive material is solder selected
from a group consisting of lead, tin, indium, bismuth, antimony,
gold, silver, cadmium and alloys thereof and their alloys .

188. The method as claimed in Claim 91, further comprising:

25 performing the method on at least one terminal on an
electronic component, wherein:

0 the wire is made primarily of a metal selected from a
group consisting of gold, copper, aluminum, silver, lead, tin,
indium and their alloys;

the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys;

5 a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and alloys thereof and their alloys.

189. The method as claimed in Claim 93, further comprising:

10 performing the method on at least one terminal on an electronic component, wherein:

the wire is made primarily of a metal selected from a group consisting of gold, copper, aluminum, silver, lead, tin, indium and alloys thereof;

15 the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys;

20 a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and their alloys.

190. The method as claimed in Claim 95, further comprising:

25 performing the method on at least one terminal on an electronic component, wherein:

the wire is made primarily of a metal selected from a group consisting of gold, copper, aluminum, silver, lead, tin, indium and their alloys;

0 the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys;

a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and alloys thereof and their alloys .

191. The method as claimed in Claim 97, further comprising:
5 performing the method on at least one terminal on an electronic component, wherein:

the wire is made primarily of a metal selected from a group consisting of gold, copper, aluminum, silver, lead, tin, indium and their alloys;

10 the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys;

15 a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and alloys thereof and their alloys.

192. The method as claimed in Claim 101, further comprising:

5 performing the method on at least one terminal on an electronic component, wherein:

the wire is made primarily of a metal selected from a group consisting of gold, copper, aluminum, silver, lead, tin, indium and their alloys;

0 the skeleton is coated with a first layer of the conductive material selected from a group consisting of nickel, cobalt, boron, phosphorous, copper, tungsten, titanium, chromium, and their alloys;

25 a top layer of the conductive material is solder selected from a group consisting of lead, tin, indium, bismuth, antimony, gold, silver, cadmium and alloys thereof and their alloys.

193. The method as claimed in Claim 88, wherein the conductive material is reactive with the wire stem; and

0 further comprising:

a barrier layer which is not reactive with the wire stem disposed between the wire stem and the conductive material.

1 . The method as claimed in Claim 93, wherein the conductive material is reactive with the wire stem; and further comprising:
a barrier layer which is not reactive with the wire stem disposed between the wire stem and the conductive material.

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195. The method as claimed in Claim 95, wherein the conductive material is reactive with the wire stem; and further comprising:
a barrier layer which is not reactive with the wire stem disposed between the wire stem and the conductive material.

10
196. The method as claimed in Claim 88, wherein:
each of two surfaces of the electronic component has at least one protuberant contact mounted thereto.

15
197. The method as claimed in Claim 90, wherein:
each of two surfaces of the electronic component has at least one protuberant contact mounted thereto.

198. The method as claimed in Claim 93, wherein:
each of two surfaces of the electronic component has at least one protuberant contact mounted thereto.

20
199. The method as claimed in Claim 97, wherein:
each of two surfaces of the electronic component has at least one protuberant contact mounted thereto.

25
200. The method as claimed in Claim 101, wherein:
each of two surfaces of the electronic component has at least one protuberant contact mounted thereto.

201. The method as claimed in Claim 88, wherein:
the wire stem is S-shaped.

- The method as claimed in Claim 90, wherein:
the wire stem is S-shaped.
203. The method as claimed in Claim 93, wherein:
the wire stem is S-shaped.
- 5 204. The method as claimed in Claim 97, wherein:
the wire stem is S-shaped.
205. The method as claimed in Claim 101, wherein:
the wire stem is S-shaped.
- 10 206. Method of forming a resilient contact structure extending
from a surface of an electronic component, comprising:
 bonding an end of a wire to a terminal on a surface of
an electronic component to extend initially in a first direction
from the surface of the electronic component;
 configuring the wire to have a shape including at least
two bends;
 severing the wire so that a severed end of the wire
extends generally in the first direction; and
 overcoating the wire and an area surrounding the bonded
end of the wire with an electrically conductive, metallic material;
 wherein:
 the shape of the wire and the mechanical properties of
the metallic material cooperate to impart resiliency to a resulting
resilient contact structure comprising the wire and the metallic
material.
- 25 207. Method for manufacturing a conductive contact on an
electronic component, comprising:
 bonding an end of a wire to a first area on a surface of
an electronic component;
 shaping the wire to extend as a wire stem from the
surface of the electronic component;

severing the wire stem so that it has a free end and a length; and

depositing a conductive coating having at least one layer on the wire stem;

5 wherein:

the conductive coating covers at least a portion of the wire stem, said portion of the wire stem commencing at the bonded end of the wire stem and continuing along its length; and

10 the conductive coating covers a second area on the surface of the electronic component, said second area being larger than and encompassing the first area.

208. Method, according to claim 207, wherein:

the conductive coating covers the entire length of the wire stem.

15 209. Method, according to claim 207, wherein:

at least one layer of the conductive coating is deposited along the entire length of the wire stem.

210. Method, according to claim 207, wherein:

the conductive coating covers only a portion of the length of the wire stem.

211. Method, according to claim 207, further comprising:

supplying the wire from a spool of wire.

212. Method, according to claim 207, wherein:

the first area is a conductive terminal disposed on the surface of the electronic component.

213. Method, according to claim 207, wherein:

the first area is a first portion of a conductive terminal; and

the second area is a second portion of the conductive

termin

214. Method, according to claim 207, further comprising:
forming a plurality of wire stems at a plurality of first
and second areas on a conductive layer of the electronic component.

5 215. Method, according to claim 207, wherein:
the wire stem is shaped in two-dimensions to define a
skeleton of a resulting contact.

10 216. Method, according to claim 207, wherein:
the wire stem is shaped in three-dimensions to define a
skeleton of a resulting contact.

217. Method, according to claim 207, wherein:
the wire stem is shaped to have an S-shape.

15 218. Method, according to claim 207, wherein:
the wire stem is shaped to extend normal to the surface
of the electronic component.

219. Method, according to claim 207, wherein:
the wire stem is shaped to extend at an angle to the
surface of the electronic component.

20 220. Method, according to claim 207, wherein:
the electronic component is an interconnection substrate.

221. Method, according to claim 207, wherein:
the electronic component is a semiconductor device.

222. Method, according to claim 221, wherein:
the semiconductor device is a silicon device.

2. Method, according to claim 221, wherein:
the semiconductor device is a gallium-arsenide device.

224. Method, according to claim 207, wherein:
the electronic component is an interconnect socket.

5 225. Method, according to claim 207, wherein:
the electronic component is a test socket.

226. Method, according to claim 207, wherein:
the electronic component is a semiconductor wafer.

0 227. Method, according to claim 207, wherein:
the electronic component is a ceramic semiconductor
package.

228. Method, according to claim 207, wherein:
the electronic component is a plastic semiconductor
package.

5 229. Method, according to claim 207, wherein:
the wire stem is bonded to the surface of the electronic
component using ultrasonic bonding equipment.

20 230. Method, according to claim 207, wherein:
the wire stem is bonded to the surface of the electronic
component using thermosonic bonding equipment.

231. Method, according to claim 207, wherein:
the wire stem is bonded to the surface of the electronic
component using thermocompression bonding equipment.

Method, according to claim 207, wherein wirebonding equipment is used to bond the end of the wire stem to the surface of the electronic component, and further comprising:

5 during shaping, controlling all aspects of geometric characteristics of the wire stem with a specific set of commands entered into an electronic control system of the wirebonding equipment.

233. Method, according to claim 207, wherein:

.0 automated wirebonding equipment, controllable by a software algorithm, is used to shape the wire stem and to determine the coordinate of a tip of its free end.

234. Method, according to claim 207, further comprising:

shaping the wire stem with automated equipment controlled by a control system, according to a set of specified parameters.

.5 235. Method, according to claim 207, wherein:

the wire is severed by generating a spark.

236. Method, according to claim 207, wherein:

the wire is severed using a flame-off technique.

237. Method, according to claim 207, further comprising:

20 in same step as severing the wire stem, forming a ball at a tip of the free end of the wire stem.

238. Method, according to claim 207, wherein:

the conductive coating is deposited by an electrochemical process.

?5 239. Method, according to claim 207, wherein:

the conductive coating is deposited by an electrolytic plating process.

2 . Method, according to claim 207, wherein:
the conductive coating is deposited by an electroless
plating process.

241. Method, according to claim 207, wherein:
5 the conductive coating is deposited by a process selected
from the group consisting of physical vapor deposition and chemical
vapor deposition.

242. Method, according to claim 207, wherein:
10 the conductive coating is deposited by a process that
involves the decomposition of gaseous, liquid or solid precursors.

243. Method, according to claim 207, further comprising:
15 providing the conductive coating with a plurality of
local protrusions.

244. Method, according to claim 243, further comprising:
reducing a contact resistance between the conductive
contact and an electronic device to which the conductive contact
is mated with the local protrusions.

245. Method, according to claim 243, wherein:
20 the local protrusions are provided by dendritic growth
of an electroplated deposit.

246. Method, according to claim 243, wherein:
the local protrusions are provided by incorporation of
foreign particulates into the conductive coating during its
deposition onto the wire stem.

247. Method, according to claim 243, wherein:
5 a uniform first layer of the conductive coating is
deposited onto the wire stem; and
further comprising forming the local protrusions in a

subsequently deposited layer of the conductive coating.

248. Method, according to claim 247, wherein:
the first layer is selected to be a material suitable
for imparting resilient properties to the conductive contact; and
5 the subsequently deposited layer is selected to be a
material that reduces the contact resistance between the
conductive contact and the electronic device to which the
conductive contact is mated.

249. Method, according to claim 207, wherein:
0 an outer one of a plurality of layers deposited on the
wire stem includes a conductive material selected from the group
consisting of gold, silver, elements of the platinum group, and
their alloys.

250. Method, according to claim 207, wherein:
.5 the wire stem comprises a material selected from the
group consisting of gold, aluminum, copper, beryllium, cadmium,
silicon, magnesium, silver and platinum, and their alloys.

251. Method, according to claim 207, wherein:
20 the wire stem has a diameter between 0.0005 and 0.005
inches.

252. Method, according to claim 251, wherein:
the wire stem has a diameter between 0.0007 and 0.003
inches

253. Method, according to claim 207, wherein:
25 the conductive coating comprises a material selected from
the group consisting of nickel, copper, cobalt, iron, and their
alloys.

254. Method, according to claim 207, wherein:

the coating has a tensile strength in excess of 80,000
pounds per square inch.

255. Method, according to claim 207, further comprising:
during deposition of the conductive coating, causing a
5 compressive internal stressing in the conductive coating.

256. Method, according to claim 207, wherein:
the nickel has a thickness between 0.00005 and 0.007
inches.

257. Method, according to claim 256, wherein:
10 the nickel has a thickness between 0.00010 and 0.003
inches.

258. Method, according to claim 207, wherein:
the conductive coating is deposited as two or more
layers, at least the outer layer of the two or more layers being
15 a conductive material.

259. Method, according to claim 258, wherein:
a first layer, deposited onto the wire stem, is nickel;
and
20 a second layer deposited over the first layer is a
material selected from the group consisting of gold, silver,
elements of the platinum group, and their alloys.

260. Method, according to claim 258, wherein:
the two or more layers are selected to tailor the
mechanical characteristics of the protuberant contact.

261. Method, according to claim 207, wherein:
25 the first area includes a layer of material selected from
the group consisting of gold and aluminum.

- 2
21. Method, according to claim 207, wherein:
the first area and the second area are portions of a
conductive layer previously applied to the surface of the
electronic component.
- 5 263. Method, according to claim 262, further comprising:
after bonding, removing the conductive layer from the
electronic component, selectively, in all but the first and second
area.
- 10 264. Method, according to claim 207, further comprising:
establishing a predetermined resiliency for the contact
based on a shape of the wire stem and characteristics of the
conductive coating selected from the group consisting of thickness,
yield strength, and elastic modulus.
- 15 265. Method, according to claim 207, wherein:
the wire stem comprises a material having a first
strength; and
the conductive coating comprises a material having a
second strength which is greater than the strength of the first
material.
- 20 266. Method, according to claim 207, wherein:
the conductive contact has controlled characteristics
selected from the group consisting of physical properties,
metallurgical properties, mechanical properties, bulk and surface.
- 25 267. Method, according to claim 207, wherein:
the raised conductive contact is shaped as a pin-shaped
contact; and
the electronic component is a pin grid array package.
268. Method, according to claim 267, wherein:
the pin grid array package is a ceramic pin grid array

packag

269. Method, according to claim 267, wherein:

the pin grid array package is a plastic pin grid array package.

5 270. Method, according to claim 207, further comprising:

bonding, shaping and severing a plurality of wire stems, a first portion of the wire stems originating from a first level of the electronic component, a second portion of the wire stems originating from a second level of the electronic component, said first level and said second level being non-coplanar with one another;

wherein:

the free ends of said plurality of wire stems are severed to be substantially coplanar with one another.

15 271. Method, according to claim 270, wherein:

the free ends of the wire stems are severed to extend to a plane parallel to at least one of the first and second levels of the electronic component.

20 272. Method, according to claim 207, further comprising:

bonding, shaping and severing a plurality of wire stems, a first portion of the wire stems originating from a first electronic component, a second portion of the wire stems originating from a second electronic component;

wherein:

25 the free ends of said plurality of wire stems are severed to be substantially coplanar with one another.

273. Method, according to claim 272, wherein:

the free ends of the wire stems are severed to extend to a plane parallel to at least one of the first and second electronic components.

274. Method, according to claim 207, further comprising:
bonding, shaping and severing a plurality of wire stems
originating from the electronic component, a first portion of the
wire stems terminating on a first electronic device, a second
portion of the wire stems terminating on a second electronic
device.

275. Method, according to claim 207, further comprising:
bonding, shaping and severing a plurality of wire stems;
wherein:

a first portion of the wire stems are severed to
terminate at a first level above the surface of the electronic
component; and

a second portion of the wire stems are severed to
terminate at a second level above the surface of the electronic
component, said first level and said second level being non-
coplanar.

276. Method, according to claim 207, further comprising:
bonding, shaping and severing a plurality of wire stems
originating from at least two electronic components, each of a
portion of the wire stems extending from a corresponding one of the
at least two electronic components.

277. Method, according to claim 276, further comprising:
interconnecting the first and second electronic
components.

278. Method, according to claim 276, wherein:
one of the first and second electronic components is a
capacitor.

279. Method, according to claim 276, wherein:
one of the first and second electronic components is a

resist. .

280. Method, according to claim 207, further comprising:
bonding, shaping and severing a plurality of wire stems;
wherein:

5 a first portion of the wire stems are severed to
terminate at a first level above the surface of the electronic
component; and

10 a second portion of the wire stems are severed to
terminate at a second level above the surface of the electronic
component, said first level and said second level being non-
coplanar; and

further comprising:

15 terminating the first portion of the wire stems on an
interconnection substrate; and

20 terminating the second portion of the wire stems on an
electronic device disposed between the interconnection substrate
and the electronic component.

281. Method, according to claim 280, wherein:

25 the electronic component is a bare, unpackaged
semiconductor device.

282. Method, according to claim 280, wherein:

the electronic device is a capacitor.

283. Method, according to claim 280, wherein:

25 the electronic component is a bare, unpackaged
semiconductor device; and

the electronic device is a capacitor.

284. Method, according to claim 207, wherein:

30 the conductive coating comprises solder, and the
conductive contact is a tower-like solder contact extending from
the surface of the electronic component.

285. Method, according to claim 284, further comprising:
prior to depositing the conductive coating on the wire
stem, depositing a barrier layer on the wire stem, said barrier
layer being a material selected to prevent a reaction between the
conducting coating and the wire stem.
- 5
286. Method, according to claim 285, wherein:
the wire stem is gold; and
the barrier layer is a material selected from the group
consisting of nickel, copper, cobalt, iron, or their alloys.
- 10
287. Method, according to claim 207, further comprising:
establishing the soldering characteristics of the
electronic substrate by selection of a material composition of the
conducting coating.
- 15
288. Method, according to claim 207, wherein:
establishing the long term effects from interaction of
the raised conductive contact with solder. by selection of a
material composition of the conductive coating.
- 20
289. Method, according to claim 207, wherein:
the wire stem has a diameter between 0.0005 and 0.005
inches; and
further comprising:
prior to depositing the solder, coating the wire stem
with nickel having a thickness between 0.00005 and 0.007 inches.
- 25
290. Method, according to claim 289, wherein:
the wire stem has a diameter between 0.0007 and 0.003
inches; and
the nickel has a thickness between 0.00010 and 0.003
inches.

251. Method, according to claim 207, further comprising:
shaping the wire stem in a form of a loop, said loop
originating and terminating in a selected second area on the
surface of the electronic component.

5 292. Method, according to claim 207, further comprising:
shaping the wire stem in a form of a loop, said loop
originating on a conductive terminal of the electronic component,
said loop terminating on a sacrificial element.

0 293. Method, according to claim 292, further comprising:
after bonding the free end of the wire stem to the
sacrificial conductor, removing the sacrificial element.

.5 294. Method, according to claim 293, wherein:
the sacrificial element is removed after depositing the
conductive coating on the wire stem.

20 295. Method, according to claim 293, wherein:
the sacrificial element is removed before depositing the
conductive coating on the wire stem.

25 296. Method, according to claim 207, further comprising:
shaping the wire stem in a form of a loop, said loop
originating on a sacrificial element, said loop terminating on a
conductive terminal of the electronic component.

297. Method, according to claim 207, further comprising:
shaping the wire stem in a form of a loop, said loop
originating in the second area on the surface of the electronic
component, said loop terminating in a third area distinct from the
second area.

2 Method, according to claim 207, further comprising:
shaping the wire stem in a form of a loop, said loop
originating in a third area on the surface of the electronic
component, said third area distinct from said second area, and said
loop terminating in the second area.
5

299. Method, according to claim 207, further comprising:
shaping a first length of the wire stem into a first
loop, said first loop originating and terminating on a conductive
terminal disposed on the surface of the electronic component;
.0 severing the first length of the wire stem;
shaping a second length of the wire stem into a second
loop, said second loop originating and terminating on the
conductive terminal and being parallel to the first loop;
.5 severing the second length of the wire; and
depositing a common conductive coating of solder on the
first and second loops and onto the conductive terminal to form a
controlled aspect ratio column of solder disposed on the conductive
terminal of the electronic component; and
.0 prior to depositing the common conductive coating of
solder, coating the two loops with a barrier layer;
wherein:
the wire is gold;
the solder is an alloy of lead and tin; and
the barrier layer is a nickel alloy having a thickness
25 on the wires sufficient to deter a reaction between the solder of
the conductive coating and the gold of the wire.

300. Method, according to claim 207, further comprising:
prior to severing the wire, bonding an intermediate
portion of the wire to the electronic component, thereby forming
0 a skeleton on the surface of the electronic component.

..... method, according to claim 300, wherein:
the intermediate portion is bonded to the second area of
the electronic component.

302. Method, according to claim 300, further comprising:

5 after bonding the intermediate portion of the wire to
the electronic component, coating the skeleton with a solder mass.

303. Method, according to claim 302, further comprising:

prior to coating the skeleton with the solder mass,
coating the skeleton with a barrier layer.

.0 304. Method, according to claim 300, further comprising:

after bonding the intermediate portion of the wire to
the electronic component, severing the wire to have a subsequent
end for bonding as a subsequent skeleton on the surface of the
electronic component.

5 305. Method, according to claim 300, wherein:

a plurality of skeletons are formed on a common second
area of the electronic component.

306. Method, according to claim 305, wherein:

the common second area is a terminal.

20 307. Method, according to claim 305, wherein:

the plurality of skeletons are overcoated in a common
depositing step.

308. Method, according to claim 300, further comprising:

5 after bonding the intermediate portion of the wire to
the electronic component, without severing the wire, continuing to
bond subsequent intermediate portions of the wire, without
severing, to form a sequence of skeletons on the surface of the
electronic component.

309. Method, according to claim 308, further comprising:
bonding and severing a last one of the skeletons adjacent
the first area.

310. Method, according to claim 308, wherein:
5 the sequence of skeletons defines an enclosed area on the
surface of the electronic component.

311. Method, according to claim 300, further comprising:
depositing solder as the conductive coating in a manner
that the solder fills the enclosed area.

312. Method, according to claim 301, further comprising:
0 bringing the enclosed, solder-filled area into contact
with an electronic device selected from the group consisting of
heat sinks and substrates.

313. Method, according to claim 207, further comprising:
repeating the steps of bonding, shaping and severing for
.5 a plurality of wire stems, wherein the conductive coating is
deposited as a common coating onto the plurality of wire stems.

314. Method, according to claim 313, wherein:
the plurality of wire stems are arranged in an array
20 pattern on the surface of the electronic component.

315. Method, according to claim 207, further comprising:
bonding the second end of the wire stem to the first area
of the electronic component to form a loop; and
further shaping the loop to extend from the electronic
25 component in three-dimensions.

316. Method for manufacturing electrical contacts on a surface of an electronic component, comprising, for each raised electrical contact:

5 bonding a one end of a wire to a first area on the surface of the electronic component, said surface of the electronic component disposed in a plane defined by an "x" axis and a "y" axis orthogonal to the "x" axis;

0 with the one end of the wire bonded to the area on the surface of the electronic component, extending the wire in a "z" axis mutually orthogonal to the "x" and "y" axes, and in at least one of the "x" or "y" directions;

5 after extending the wire, severing the wire so that it has a length and a free end opposite the one end;

10 while extending the wire, shaping the wire to have at least one U-shaped bend along its length; and

15 after extending and shaping the wire, depositing a first electrically conductive, metallic material to cover a second area on the surface of the substrate which is greater than and which subsumes the first area to which the one end of the wire is bonded and to cover at least a portion of the length of the wire, said portion of the wire extending from the one end of the wire along the length of the wire towards the free end of the wire.

317. Method, according to claim 316, further comprising:

depositing at least two coatings on the wire.

25 318. Method of connecting a first electronic component to a second electronic component, comprising:

30 providing a third electronic component between the first and the second electronic components, said third electronic component having a first plurality of resilient contact structures extending from a first surface thereof for contacting a corresponding plurality of contact points on a face of the first electronic component, said third electronic component having a second plurality of resilient contact structures extending from a

second surface thereof for contacting a corresponding plurality of contact points on a face of the second electronic component; and
within the third electronic component, making a connection between the first plurality of resilient contact structures and the second plurality of resilient contact structures.

319. Method, according to claim 318, wherein:
the first electronic component is a semiconductor package.

320. Method, according to claim 318, wherein:
the first electronic component is an unpackaged semiconductor die.

321. Method, according to claim 318, wherein:
the second electronic component is a printed circuit board.

322. Method, according to claim 318, wherein:
the third electronic component provides for demountable interconnection between the first and second electronic components.

323. Method of making a temporary connection between a first electronic component and a second electronic component, and subsequently making a permanent connection between the first electronic component and a third electronic component, comprising:
mounting a plurality of resilient contact structures to a surface of the first electronic component;
urging the first electronic component against the second electronic component to effect a temporary connection between the first electronic component and the second electronic component;
removing the second electronic component; and
mounting the first electronic component to the third electronic component.

324. Method, according to claim 323, further comprising:
while the first and second electronic components are temporarily connected, performing at least one function selected from the group consisting of burn-in and testing of the first electronic component.

325. Interposer, comprising:

a dielectric substrate having a first surface and a second surface opposite the first surface, a first plurality of conductive areas on the first surface, a second plurality of conductive areas on the second surface, each of the first plurality of conductive areas electrically connected to a corresponding one of the second conductive areas;

a first plurality of resilient contact structures extending from the first conductive areas; and

a second plurality of contact structures extending from the first conductive areas.

326. Interposer, according to claim 325, wherein:

the first plurality of resilient contact structures are compliant contact structures.

327. Interposer, according to claim 326, further comprising:

at least one standoff element fabricated on the first surface, to limit deflection of the first plurality of resilient contact structures.

328. Interposer structure, according to claim 325, wherein:

the electrical connections between the first plurality of conductive areas and the second plurality of conductive areas is plated through holes.

3. Interposer, according to claim 325, wherein:
the second plurality of contact structures are resilient
contact structures.

5 330. Interposer, according to claim 329, wherein:
the second plurality of contact structures are non-
resilient contact structures.

0 331. Interposer, according to claim 325, wherein:
at least one of either of the first plurality of
resilient contact structures and the second plurality of contact
structures comprises at least two contact structures.

332. Interposer, comprising:
a dielectric substrate having a first surface and a
second surface opposite the first surface, and having a plurality
of conductive areas on the first surface;
a plurality of resilient contact structures mounted to
the plurality of conductive areas, and having a first portion
extending beyond the first surface of the dielectric substrate for
making a connection to a first electronic component, and having a
second portion contiguous with the first portion and extending
beyond the second surface of the dielectric substrate for making
an interconnect to a second electronic component.

333. Interposer, according to claim 332, wherein:
the second portions of the plurality of resilient contact
structures extend through holes in the substrate.

5 334. Interposer, according to claim 325, wherein:
the second plurality of contact structures are resilient
contact structures; and
further comprising:
conductive traces on both surfaces of the dielectric
0 substrate.

335. Interposer, according to claim 325, further comprising:
standoff elements on the first side of the substrate

336. Interposer, according to claim 325, further comprising:
a plurality of conductive areas on the first side of the
5 substrate;

wherein:

the first plurality of resilient contact structures
extend from the conductive areas.

337. Interposer, according to claim 336, further comprising:
.0 a plurality of holes extending through the substrate; and
wherein:

the second contact structures extend from the conductive
areas through the plurality of holes, to the second side of the
substrate.

.5 338. Interposer, according to claim 325, wherein:

the first plurality of resilient contact structures are
arranged in pairs.

339. Interposer, according to claim 325, further comprising:
a plurality of conductive areas on the first side of the
20 substrate; and

a plurality of holes extending through the substrate;
wherein:

the first plurality of resilient contact structures
extend through the plurality of holes beyond the first side of the
substrate to beyond the second side of the substrate; and

15 the first plurality of resilient contact structures are
electrically connected to the conductive areas.

3. Interposer, comprising:
a substrate having a plurality of holes extending from
a first surface of the substrate to a second surface of the
substrate;

5 a plurality of contact structures, each contact structure
disposed within a corresponding hole; and
means for supporting the contact structures within the
holes.

341. Interposer, according to claim 340, wherein:

0 the contact structures are resilient contact structures.

342. Interposer, according to claim 340, wherein:

the means for supporting is an elastomeric material.

343. Interposer, according to claim 342, wherein:

5 at least a portion of the elastomeric material is
electrically conductive.

344. Interposer, according to claim 340, further comprising:

a metallic surface within each hole; and

wherein:

the means for supporting is solder.

20 345. Interposer, according to claim 340, wherein:

the substrate is metallic, and is overcoated with an
insulating material.

346. Method of manufacturing shaped contact structures,
comprising:

25 mounting a plurality of free-standing wire stems to a
substrate with a first mechanism; and

shaping the wire stems with a second mechanism which is
external to the first mechanism.

34 . Semiconductor package, comprising:

 a first insulating layer;

 a first conductive layer disposed on a first surface of the first insulating layer and patterned to have a first plurality of conductive traces;

 a second insulating layer;

 a second conductive layer disposed on a first surface of the second insulating layer and patterned to have a second plurality of conductive traces;

 the first conductive layer being in contact with the second insulating layer;

 the second conductive and insulating layers are arranged and disposed so that outer portions of the first plurality of conductive traces are exposed;

 a first plurality of electrical contact structures mounted to outer portions of the first plurality of conductive traces; and

 a second plurality of electrical contact structures mounted to the second plurality of conductive traces.

0 348. Semiconductor package, according to claim 347, wherein:
the first plurality of electrical contact structures
extend to a plane; and
the second plurality of electrical contact structures
extend to the plane.

25 349. Semiconductor package, according to claim 347, wherein:
 the first plurality of electrical contact structures are
resilient contact structures; and
 the second plurality of electrical contact structures are
resilient contact structures.

0 350. Semiconductor package, according to claim 347, further comprising:
means for receiving a semiconductor device;

wherein:

the second conductive and insulating layers are arranged and disposed so that inner portions of the first plurality of conductive traces are exposed for connecting to a semiconductor device; and

further comprising:

means for connecting the semiconductor device to the exposed inner portions of the first plurality of conductive traces; and

means for connecting the semiconductor device to the second plurality of conductive traces.

a first plurality of electrical contact structures mounted to outer portions of the first plurality of conductive traces; and

a second plurality of electrical contact structures mounted to the second plurality of conductive traces.

351. Semiconductor device, comprising:

a semiconductor die having a front surface and a back surface;

a plurality of free-standing interconnect structures mounted to the front surface of the semiconductor die; and

a plurality of free-standing heat-dissipating structures mounted to the back surface of the semiconductor die.

352. Semiconductor device, according to claim 351, wherein:

the interconnect structures are resilient contact structures.

353. Semiconductor device, according to claim 351, wherein:

the interconnect structures are compliant contact structures.

354. Semiconductor device, according to claim 351, wherein:

the free-standing heat-dissipating structures are wires

mounting to the back surface of the semiconductor die.

355. Semiconductor device, according to claim 351, wherein:
the free-standing interconnect structures are of a first
material; and

5 the free-standing heat-dissipating structures are of a
second material which is different from the first material.

356. Semiconductor device, according to claim 355, wherein:
the free-standing interconnect structures and the free-
standing heat-dissipating structures are overcoated with a common
0 material.

357. Semiconductor device, according to claim 351, further
comprising:

5 a layer of a metallic material disposed between the free-
standing heat-dissipating structures and the back surface of the
semiconductor die.

the interconnect structures are resilient contact
structures.

358. Semiconductor device, comprising:
a semiconductor die having a front surface and a back
0 surface; and
a plurality of free-standing resilient contact structures
mounted to the front surface of the semiconductor die.

359. Semiconductor device, according to claim 358, further
comprising:

5 conductive pads disposed on the front surface of the
semiconductor die; and

wherein:

one contact structure is mounted to each conductive pad.

360. Semiconductor device, according to claim 358, wherein the

resili : contact structures each comprise:

a wire stem bonded at one end to the front surface of the semiconductor die and configured to have a springable shape; and
an overcoat material applied over the wire stem and over
a portion of the front surface of the semiconductor die.

5

361. Semiconductor device, according to claim 358, wherein:
the resilient contact structures are compliant.

362. Method of assembling an electronic assembly, comprising:

0 preparing a first wiring substrate with a first plurality
of semiconductor devices mounted to the first wiring substrate;
preparing a second wiring substrate with a second
plurality of semiconductor devices mounted to the second wiring
substrate;

5 the second wiring substrate has electrical contact
structures mounted thereto for connecting to contact pads on the
first wiring substrate; and

the first and second wiring substrates are stacked, one
atop the other, and are interconnected to one another with the
electrical contact structures.

363. Method, according to claim 362, wherein:

the first wiring substrate has two sides;

the second wiring substrate has two sides;

the first plurality of semiconductor devices are mounted
to both sides of the first wiring substrate; and

25 the second plurality of semiconductor devices are mounted
to both sides of the second wiring substrate.

364. Method, according to claim 362, further comprising:

10 a first plurality of resilient contact structures
electrically interconnecting the first plurality of semiconductor
devices to the first wiring substrate; and

a second plurality of resilient contact structures

electrically interconnecting the second plurality of semiconductor devices to the second wiring substrate.

365. Method of mounting a free-standing contact structure to an electronic component, comprising:

5 providing a pierceable mass of conductive material on a terminal on an electronic component;
inserting an end of a wire into the conductive material;
severing the wire to be free-standing; and
overcoating the wire and the mass with a conductive,
0 metallic material.

366. Method, according to claim 365, wherein:

the mass of conductive material is solder.

367. Method, according to claim 365, wherein:

the mass of conductive material is conductive epoxy.

368. Method, according to claim 365, wherein:

the overcoating is performed by plating.

369. Method of performing wirebonding, comprising:

bonding a bond wire to a terminal with a capillary;
playing the bond wire out of the capillary;
severing the bond wire with a discharge from an
electrode; and

20 while severing the bond wire, illuminating at least one
of the electrode and the bond wire with ultraviolet light.

370. Method, according to claim 369, further comprising:

15 prior to severing the bond wire, configuring the bond
wire to have a springable shape.

371. Method of forming a ball at an end of a wirebond wire,
comprising:

causing an electrical discharge between an electrode and a bond wire; and

while causing the electrical discharge, illuminating at least one of the electrode and the bond wire with ultraviolet light.

372. Method of performing wirebonding, comprising:
bonding a bond wire to a terminal with a capillary;
playing the bond wire out of the capillary;
while playing the bond wire out of the capillary,
providing a gas flow within the capillary.

373. Method, according to claim 372, further comprising:
while playing the bond wire out of the capillary,
configuring the bond wire to have a springable shape.

374. Method of making engineering changes in an interposer having a first plurality of contact structures extending from a first side of a substrate and a second plurality of contact structures extending from a second side of the substrate, comprising:

providing a plurality of conductive traces on at least one side of the substrate; and
routing the conductive traces so as to interconnect selected ones of the first plurality of contact structures with selected ones of the second plurality of contact structures.